

Before the
Federal Communications Commission
Washington, D.C. 20554

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

In the Matter of)
)
Amendment of Parts 2.106 and 25.202)
of the Commission's Rules to Permit)
Operation of NGSO FSS Systems) RM No. 9147
Co-Frequency with GSO and Terrestrial)
Systems in the 10.7-12.7 GHz,)
12.75-13.25 GHz, 13.75-14.5 GHz,)
and 17.3-17.8 GHz Bands, and to)
Establish Technical Rules Governing)
NGSO FSS Operations in these Bands)

REPLY COMMENTS OF SKYBRIDGE

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Summary

SkyBridge hereby replies to the comments and other pleadings filed in response to its Petition for rulemaking, in which SkyBridge requested that the Commission initiate a rulemaking proceeding to amend its Rules to permit NGSO FSS systems to operate in the U.S. co-frequency with GSO and FS systems in certain Ku-bands. The rule changes proposed would facilitate the establishment of a new generation of LEO satellite systems, capable of operating co-frequency with GSO and FS licensees, while causing no noticeable degradation to the quality of the service or availability of GSO and FS links, and without imposing operational constraints on GSO and terrestrial operators. One example of such a system is the "SkyBridge System," a global LEO constellation designed to provide a wide range of data, voice, and video broadband services.

None of the comments reject outright the proposition that co-frequency operation by GSO, FS, and NGSO systems at Ku-band is feasible. And none offers any credible reason for delaying the initiation of a rulemaking to establish rules governing such frequency sharing. In fact, the focus of the vast majority of the substantive comments is misplaced, dwelling on the particular characteristics of the SkyBridge System, rather than on the real issue raised in the Petition -- whether adoption of the "hard limits" on NGSO operation proposed in the Petition will fully protect GSO and FS systems. With respect to that critical issue, no party articulated any technically substantive objection to the e.p.f.d., a.p.f.d., and p.f.d. limits proposed in the Petition.

The critical goals of increasing both marketplace competition and spectrum efficiency are advanced by permitting the introduction of new services into the Ku-band, so long as GSO and FS systems are fully protected. Ensuring that GSO and FS systems can operate undisturbed by NGSO systems lies at the heart of SkyBridge's proposal. The comments provide no rational reason to believe otherwise.

The Petition affords the Commission the opportunity to chart the course for an entirely new generation of satellite systems -- systems that do not require an exclusive reservation of scarce spectrum resources and which can utilize the vast amount of space beyond the GSO orbit that is presently unused. None of the comments received offer any credible reason for delaying consideration of the issues raised in the Petition.

Therefore, the Commission should proceed expeditiously to issue a Notice of Proposed Rulemaking based on the proposals contained in the Petition.

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RM No. 9147

REPLY COMMENTS OF SKYBRIDGE

SkyBridge L.L.C. ("SkyBridge") hereby replies to the comments and other pleadings filed in the above-captioned proceeding in response to its July 3, 1997, petition for rulemaking (the "Petition").

In the Petition, SkyBridge requested that the Commission initiate a rulemaking proceeding to amend Sections 2.106 and 25.202 of its Rules to permit non-geostationary orbit ("NGSO") Fixed-Satellite Service ("FSS") systems to operate in the U.S. co-frequency with geostationary orbit ("GSO") (both FSS and Broadcast-Satellite Service ("BSS")) and terrestrial systems in the 10.7-12.7 GHz, 12.75-13.25 GHz, 13.75-14.5 GHz, and 17.3-17.8 GHz bands, and to establish technical rules governing NGSO FSS operations in these bands. The Petition was placed on Public

Notice on July 28, 1997,^{1/} and comments and oppositions were filed on August 27, 1997, by 11 parties.^{2/}

The rule changes proposed in the Petition would facilitate the establishment of a new generation of low Earth orbit ("LEO") satellite systems, which are capable of operating co-frequency with Ku-band GSO and terrestrial licensees, while causing no noticeable degradation to the quality of the service or availability of GSO and terrestrial communications links, and without imposing operational constraints on GSO and terrestrial operators. One example of such a system is the "SkyBridge System,"^{3/} a global LEO constellation designed to provide a wide range of data, voice, and video broadband services.

^{1/} See Public Notice, Report No. 2213.

^{2/} Teledesic Corporation ("Teledesic") and Loral Space & Communications Ltd. ("Loral") filed comments in support of the Petition (the "Teledesic Comments" and "Loral Comments" respectively). Hughes Communications, Inc. ("Hughes"), United States Satellite Broadcasting Company, Inc. ("USSB"), Home Box Office, ("HBO"), Telecommunications Industry Association ("TIA") and Harris Corporation-Farion Division ("Harris") filed comments (the "Hughes Comments," "USSB Comments," "HBO Comments," "TIA Comments" and "Harris Comments," respectively). PanAmSat Corporation ("PanAmSat"), AMSC Subsidiary Corporation ("AMSC"), DirecTV, Inc. ("DirecTV") and Tempo Satellite, Inc. (Tempo") filed oppositions to the Petition (the "PanAmSat Comments," "AMSC Comments," "DirecTV Comments" and "Tempo Comments," respectively).

^{3/} See Application of SkyBridge L.L.C. for Authority to Launch and Operate a Global Network of Low Earth Orbit Communications Satellites Providing Broadband Services in the Fixed Satellite Service (filed February 28, 1997, File No. 48-SAT-P/LA-97) (the "Application"), and amendment thereto (filed July 3, 1997, File No. 89-SAT-AMEND-97) (the "Amendment"). The Application and Amendment were placed on Public Notice, Report No. SPB-98, released on August 28, 1997.

As discussed in detail below, none of the comments reject outright the proposition that co-frequency operation by GSO, terrestrial, and NGSO systems at Ku-band is feasible. And none offers any credible reason for delaying the initiation of a rulemaking to establish rules governing such frequency sharing. In fact, the focus of the vast majority of the substantive comments is misplaced, dwelling on the particular characteristics of the SkyBridge System, rather than on the real issue raised in the Petition -- whether adoption of the "hard limits" on NGSO operation proposed in the Petition will fully protect GSO and FS systems. With respect to that critical issue, no party articulated any technically substantive objection to the equivalent and aggregate power flux-density ("e.p.f.d." and "a.p.f.d.", respectively) and power flux density ("p.f.d.") limits proposed in the Petition. Therefore, the Commission should proceed expeditiously to issue a Notice of Proposed Rulemaking ("NPRM") based on the proposals contained in the Petition.

I. THE ISSUES RAISED IN THE PETITION ARE RIPE FOR RESOLUTION.

The Petition raises the key regulatory and technical issues that must be addressed if co-frequency operation by NGSO, GSO and terrestrial systems at heavily utilized bands such as the Ku-band is to be successful. These issues include, for example, the status of such NGSO systems relative to GSO and terrestrial systems, and the nature of the technical and operational limits that should be imposed on the NGSO systems to protect those other systems. The Petition proposes a generic

framework for resolving these issues, designed to accommodate various NGSO system architectures and frequency sharing approaches.^{4/}

As urged by Teledesic, "the issue of how best to accommodate evolving NGSO FSS technologies deserves careful consideration," and "a rulemaking will provide the best forum."^{5/} Loral, itself the operator of a network of a Ku-band GSO system, notes that a rulemaking "would permit satellite service operators to help refine and further develop the . . . methodology proposed."^{6/}

A. The comments offer no persuasive reason for delaying the proposed rulemaking.

Despite the absence of any meaningful challenge to the technical solutions proposed in the Petition, a variety of objections to the proposed rulemaking nonetheless were advanced by the commenting parties. None has any merit whatsoever; some border on the frivolous.

First, although the SkyBridge System is merely one example of the type of system that the proposed rulemaking would address, most parties illogically focused their remarks solely on the specific technical characteristics of the SkyBridge System, rather than the specific regulations, especially the "hard limits," proposed in

^{4/} As discussed in SkyBridge's Application, the SkyBridge System can be licensed by the Commission via a series of waivers of certain regulations identified therein. Application at 103. Grant of the instant Petition, however, will enable the Commission to formulate a more comprehensive regulatory structure, equally applicable to other NGSO systems.

^{5/} Teledesic Comments at 1.

^{6/} Loral Comments at 4.

the Petition.^{7/} The real issue in this proceeding is not the operation and performance of the SkyBridge System -- those issues can and should be addressed within the context of the SkyBridge Application^{8/} -- but the limits proposed in the Petition to protect GSO and FS systems from any NGSO system. These limits depend on the parameters of the GSO and FS systems to be protected, and not on the characteristics of a proposed NGSO system.

Second, the oppositions were notable for the paucity of technical support for the few arguments that were proffered in opposition to the Petition. For example, PanAmSat, one of the few commentators that delved into any technical discussion, submitted a "preliminary engineering report" that utterly fails to address substantively the issues relevant to the rulemaking (including the hard limits), relying instead on gratuitous and unfounded generalities about the SkyBridge System. If the commenting parties had any serious, concrete technical concerns, they were obliged to provide the factual predicate underlying their objections.

Third, some of the commenting parties argued that insufficient information on the SkyBridge System has been provided in order to assess the proposal (assuming arguendo, as noted above, that this was a relevant consideration).

^{7/} For example, PanAmSat (as well as others) asked a number of questions regarding the details of the mitigation techniques employed by SkyBridge. PanAmSat Comments at A-3-A-7 (references to the annex of PanAmSat's comments are designated herein with the prefix "A-"). While not directly relevant to the instant proceeding, comments on SkyBridge-specific matters are addressed in Section IV below.

^{8/} See Public Notice, Rept. No. SPB-98, supra.

Others simply state they need more time to analyze the proposal.^{9/} A variety of additional delaying tactics were offered, such as issuing a notice of inquiry,^{10/} or requesting SkyBridge to supplement its Petition with further information.^{11/}

Such statements lack credibility, for a variety of reasons. First, the level of detailed interference analysis contained in the Application and the Amendment thereto, as well as in the Petition, is more than adequate to obtain a fairly detailed understanding of the technological and regulatory issues. Moreover, it borders on disingenuous for some of the commentors to advance such claims, given the unprecedented effort undertaken by SkyBridge to meet with GSO and FS operators, and to foster an on-going dialogue with these parties.

Shortly after its Application was filed, SkyBridge initiated a series of meetings with senior technical representatives of, inter alia, PanAmSat, USSB, Hughes, Loral Skynet, DirecTV, GE Americom, AT&T and AT&T Laboratories, and the National Cable Television Association.^{12/} At these meetings, senior SkyBridge technical personnel presented an overview of the SkyBridge System, including, in each case, a discussion of the potential interference into GSO or FS systems, as appropriate to the audience. Questions were solicited at those meetings, and follow-

^{9/} PanAmSat Comments at 2.

^{10/} Hughes Comments at 3; TIA Comments at 3, 13.

^{11/} TIA Comments at 3, 13; Harris Comments at 4.

^{12/} Among the commentors, HBO in particular urged dialogue between GSO operators and SkyBridge. HBO Comments at 3. As evidenced by its efforts to date, SkyBridge is in complete agreement as to the value of such discussions, and plans to continue to meet with GSO and FS licensees and other interested parties.

up questions and continuing dialogue were encouraged.^{13/} No party commenting in this proceeding acted on SkyBridge's invitation to ask follow-up questions, or to provide its own system parameters to SkyBridge for a specifically-tailored interference analysis. In brief, any commenting party suffering from a lack of technical information suffers from a self-inflicted wound.^{14/}

B. The Commission need not wait until the issues raised in the Petition are resolved at the ITU level.

Another delaying tactic employed by some commentators relates to the fact that certain modifications to the ITU Radio Regulations are necessary to facilitate the full deployment of the SkyBridge System. It has to be noted, however, that NGSO systems are already permitted to operate in bands covered by ITU Article

^{13/} In addition, shortly after the Petition was placed on Public Notice, several parties with which the SkyBridge technical team had been unable to meet in person (including, inter alia, EchoStar Communications Corp., National Association of Broadcasters, Telecommunications Industry Association, Tempo Satellite Inc., American Mobile Satellite Corp., MCI Communications Corp., Orion Network Systems, Inc., Lockheed Martin Missiles and Space Company, Inc., and Home Box Office) were sent detailed technical materials, with an offer to arrange telephone conferences with the SkyBridge technical staff to answer any questions. No party availed itself of this opportunity.

^{14/} Several parties assert that further testing and analysis of the SkyBridge System must be conducted before a rulemaking can be initiated. While SkyBridge agrees that ongoing studies of frequency reuse between GSO and NGSO systems is desirable, once again, the proposed rulemaking involves not the specifics of the SkyBridge System, but the generic protection criteria that any NGSO system must meet to fully protect GSO and FS systems. For example, PanAmSat suggests that additional testing should define minimum and maximum bounds of operation in terms of, for example, "percentage of the globe observed" and the "amount of GSO avoidance employed, if applicable." PanAmSat Comments at A-5. However, the only relevant constraints from the point of view of the GSO and FS operators is the interference level into their systems. Hence, testing or limiting such parameters as "the percentage of the globe observed" or "the amount of GSO avoidance" is neither necessary nor relevant.

S22.2. This Article calls for quantified studies on NGSO/GSO frequency reuse, which, in the case of SkyBridge, have already been carried out, and which apply from a technical standpoint, ipso facto, to the other subject frequency bands (governed by Appendices 30, 30A, and 30B). Thus, SkyBridge's particular circumstances do not warrant delay in adopting rules governing U.S. operations.

Second, even assuming arguendo that this was not the case, the Commission can and should begin to examine the issues raised in the Petition before they are resolved at the ITU level. Contrary to the suggestions of some of the commentors, the Commission need not and should not await final action within the ITU before proceeding with U.S. rule revisions.

Over the past 20 years, the Commission has taken the lead internationally with regard to identifying frequency allocations, developing service rules and licensing new types of satellite communication systems. In general, parallel or supporting actions are undertaken within the ITU, but frequently only after the Commission had identified and begun to act on a concrete service proposal. Indeed, the Commission has seldom waited for final ITU action, either with the ITU Radiocommunication Sector, or by an international frequency allocation conference, such as a World Radiocommunication Conference, before adopting U.S. policies, and often, rules and allocations.

The Commission has even granted licenses to U.S. applicants in advance of final ITU action. For example, in 1982, the Commission licensed DBS systems in the U.S. prior to adoption of broadcasting-satellite service allocations and

a regional broadcasting-satellite service plan in 1983.^{15/} More recently, in the case of the "Big LEO" rulemaking and applications, the Commission granted applications to the Big LEO systems prior to WRC-95 action on feeder link allocations, and prior to adoption with the ITU Radiocommunication Sector of all necessary mechanisms for coordinating non-GSO MSS feeder links with other services allocated to the same frequencies.^{16/} In fact, work continues today within the ITU Radiocommunication Sector to address these coordination issues, even as the Big LEO satellites are being launched.

The Commission's handling of the 28 GHz NGSO and GSO applications provides another example. The Commission led -- rather than followed -- the international community at WRC-95 by, inter alia, initiating a difficult and complex rulemaking concerning terrestrial and satellite allocations in the 28 GHz band,^{17/} and by processing the applications of both NGSO and GSO broadband systems. Indeed, the Commission did not wait for final action within the ITU

^{15/} Inquiry into the Development of Regulatory Policy in Regard to Direct Broadcast Satellites for the period following the 1983 Regional Administrative Radio Conference, Report and Order, 90 F.C.C. Rcd 676 (1982).

^{16/} See, e.g., Loral/Qualcomm Partnership, L.P., Order and Authorization, DA 95-131, released Jan. 31, 1995.

^{17/} Rulemaking to Amend Parts 1, 2, 21 and 25 of the Commission's Rules to Redesignate the 27.5-29.5 GHz Frequency Band, to Reallocate the 29.5-30.0 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services ("28 GHz Proceeding"), First Report and Order and Fourth Notice of Proposed Rulemaking, 3 Comm. Reg. (P&F) 857 (1996) ("28 GHz Order").

Radiocommunication Sector, nor final action of WRC-97, to designate the additional spectrum required by the Teledesic user links and issue a license to Teledesic.^{18/}

Put simply, the Commission is willing and able to develop mechanisms for spectrum use which allow the implementation of new technologies, while affording protection to other spectrum users, in anticipation of future conforming ITU action. The Commission should do no less in the case of the SkyBridge Petition.^{19/}

^{18/} The Commission, in the 28 GHz Order, adopted a band plan which sets up separate band segments for NGSO FSS, NGSO MSS feederlinks, GSO FSS and LMDS. Although WRC-95 designated 400 MHz designation for NGSO FSS in the band 28.7-29.1 GHz, the matter of designation of the 28.6-28.7 GHz band for NGSO FSS is to be considered at WRC-97. In addition, the Commission issued a license to Teledesic on March 14, 1997, pursuant to the U.S. domestic band plan, noting that "400 MHz of paired spectrum is identified internationally for NGSO FSS operations." Teledesic Corporation, Order and Authorization, DA 97-527, released March 14, 1997 ("Teledesic Order") at para. 16.

^{19/} With regard to harmonizing the FCC and ITU allocations, Tempo correctly points out in its Comments (at 10) that, although ITU footnote S5.492 permits FSS downlink operation in the 12.2-12.7 GHz band if "such transmissions do not cause more interference or require more protection from interference than the [BSS] transmissions operating in conformity with the Region 2 Plan," the U.S. Table does not yet contain this provision. Therefore, the NPRM should include a proposal to amend Section 2.106 and Section 25.202 of the Commission's Rules to allocate the 12.2-12.7 GHz band to FSS for space-to-Earth for use by NGSO FSS systems co-frequency with GSO (including BSS) and terrestrial operations, consistent with ITU allocations.

Tempo's additional claim -- that SkyBridge has mischaracterized the U.S. allocation in the 17.3-17.8 GHz band, apparently by failing to cite the limitation in footnote US 271 of the U.S. Table, which limits the use of this band to BSS feeder links (see Tempo Comments at 11) -- is incorrect. This limitation is clearly noted in Figure 1 on page 9 of the Petition.

II. ESTABLISHING A FRAMEWORK FOR NGSO/GSO/FS SHARING AT KU-BAND THAT PLACES THE BURDEN OF NONINTERFERENCE ON NGSO SYSTEMS SERVES THE PUBLIC INTEREST.

The critical goals of increasing both marketplace competition and spectrum efficiency are advanced by permitting the introduction of new services into the Ku-band, so long as GSO and FS systems are fully protected. Ensuring that GSO and FS systems can operate undisturbed by NGSO systems lies at the heart of SkyBridge's proposal, and as Teledesic put it, if SkyBridge's proposal "works as SkyBridge claims, it may be the best solution available in the Ku-band."^{20/} The comments provide no rational reason to believe otherwise.

As detailed in the Petition, the primary means of achieving this goal is the establishment of hard limits on NGSO operations. The comments that addressed those limits will be discussed infra in Section III. Below, SkyBridge responds to the comments that questioned the wisdom of a policy choice in favor of spectrum sharing at Ku-Band.

For example, Tempo argued that the proposal is contrary to the Commission's findings that GSO and NGSO systems should be segregated into discrete spectrum blocks, citing the 28 GHz Proceeding.^{21/} However, as Teledesic -- a vigorous proponent of band segmentation in that case -- points out, that option is not available at Ku-band.^{22/} Moreover, the result reached in the 28 GHz Proceeding turned in large part on the fact that many of the various systems under consideration

^{20/} Teledesic Comments at 4.

^{21/} Tempo Comments at 6.

^{22/} Teledesic Comments at 4.

were incapable of frequency sharing without substantial redesign. The outcome of the 28 GHz Proceeding was not preordained by some immutable physical law, but by the specific design characteristics of the systems there at issue and the fact that, at Ka-band, the Commission could draw on a relatively clean slate.^{23/} Here, just the opposite is the case. If the Commission desires to maximize the efficiency with which both Ku-band spectrum and available orbital space are utilized, it can make substantial progress in that direction by adopting SkyBridge's proposal.

USSB suggested that it may be "prudent" to carve out the 12.2-12.7 GHz band to protect DBS.^{24/} However, USSB provided no substantive explanation whatsoever how its system (or any other) may be harmed by NGSO operations consistent with the proposed rules.

SkyBridge did, however, propose a partial "carve-out" of one band that is used extensively by certain FS systems. Demonstrating what TIA characterized as "an unusual respect for existing FS users,"^{25/} SkyBridge proposed that NGSO customer earth stations avoid frequencies heavily used by FS systems, and that gateway facilities be coordinated according to standard techniques to avoid interference to current terrestrial systems. With respect to coordination with FS links constructed subsequent to the siting of a gateway facility, SkyBridge proposed that the

^{23/} Id.

^{24/} USSB Comments at 3.

^{25/} TIA Comments at 4.

burden be shared between the NGSO FSS and FS operators.^{26/} No party objected to this general principle.^{27/}

Finally, Hughes urges the Commission to reject the principle advanced in the Petition that subsequent licensed NGSO systems should bear the burden of coordination with any existing NGSO systems.^{28/} Hughes' position is fundamentally flawed. Just as SkyBridge is not asking existing GSO and FS operators to make changes to their systems or operations to accommodate NGSO systems, the first-licensed NGSO operator is justified in requesting that later-deployed NGSO systems accommodate the first entrant, in the same manner that existing GSO systems are accommodated by new GSO entrants in the same bands. As described in the Application, it will be possible to design NGSO systems that can share with SkyBridge.^{29/} SkyBridge is in no way asking to be the exclusive NGSO system in the band.

^{26/} Petition at 17.

^{27/} TIA and Harris requested that the NPRM seek comment on the kinds of siting and technical requirements that should be met by SkyBridge Gateways to protect FS expansion. TIA Comments at 13; Harris Comments at 4. SkyBridge agrees that such issues are appropriate for inclusion in the rulemaking.

^{28/} Hughes Comments at 2-3. Hughes also inexplicably argues that the Commission should not proceed with a proposal that provides only one entry opportunity or benefits only one company. This comment reflects a total lack of understanding of the SkyBridge Application and the Petition. As discussed in Section III.B of this Petition, the SkyBridge proposal, including the hard limits, contemplates multiple NGSO systems. The instant Petition in no way provides only one entry opportunity or benefits only one company.

^{29/} See Application at 75.

III. THE PROPOSED HARD LIMITS WILL FULLY PROTECT GSO AND FS SYSTEMS.

In order to ensure protection of GSO FSS and BSS systems and terrestrial systems in the subject bands, SkyBridge has proposed "hard limits" on NGSO operations in the bands -- i.e., limits not to be exceeded by the NGSO operator under any circumstances.^{30/} The limits are based on:

- for the downlink, the e.p.f.d. computed taking into account all visible NGSO satellites, for the protection of GSO systems;
- for the uplink, the a.p.f.d. computed taking into account all visible NGSO earth stations, for the protection of GSO systems; and
- p.f.d. from an NGSO satellite, for the protection of FS systems.

All of the proposed limits are single entry criteria, and each new entrant would be required to meet the limits. They offer a high level of protection, never to be diminished, unlike coordination triggers between GSO systems. In the latter case, thresholds can be exceeded, following successful negotiation between the affected GSO parties. Furthermore, the long term limits have been designed to offer at least the same protection levels as the GSO coordination trigger levels, providing GSO systems full protection.^{31/}

^{30/} See Petition at 18-23.

^{31/} AMSC argues in its Comments (at 4) that NGSO operations should be "secondary" to GSO systems. Although the regulatory regime proposed by SkyBridge for NGSO systems does, at first blush, bear some resemblance to what the Commission historically has characterized as secondary status, it is in no one's interest, least of all AMSC's, to employ that concept here.

While licensees in a secondary service clearly are prohibited from causing interference to the primary service, determining whether a given secondary licensee has failed to comply with that obligation can be exceedingly complex.

(continued...)

No FSS or FS operator directly challenged the e.p.f.d., p.f.d, or a.p.f.d. masks proposed. The only technically substantive comments on these limits were raised by DirecTV. As discussed below, the proposed limits will fully protect DirecTV's (and other) DBS operations.

A. The limits will fully protect existing DBS systems, and will not constrain innovation and expansion of those systems.

1. Current systems.

DirecTV raises the concern that SkyBridge's proposed e.p.f.d. limits would result in interference to DirecTV's current service, and included an I/N computation purporting to show an interference level margin of -6.8 dB.^{32/}

^{31/} (...continued)
Defining in a given case what constitutes "harmful" or "objectionable" interference can prove both time-consuming and contentious, as can identifying the source of that interference.

The "hard limits" proposed by SkyBridge define thresholds beyond which a NGSO licensee cannot go. Operating below those levels is permitted; operating above them -- regardless of whether such operation causes "observable" interference to a GSO or FS licensee -- is prohibited.

The traditional "secondary" service concept proposed by AMSC provides far less practical protection to AMSC (and other GSO or FS licensee). Rather than invite future squabbles over who is causing how much interference to whom, properly selected hard limits eliminate the potential for such controversies altogether, ensuring that GSO and FS licensees operate undisturbed by NGSO systems.

^{32/} DirecTV Comments at 6. DirecTV argues that SkyBridge based its calculations on Appendix 30 parameters, and not "real-world values." In Appendix 30, levels of protection are prescribed for specified carriers. The long term e.p.f.d. values were therefore derived from the aggregate C/I allowances defined in Appendix 30 and the present proposed revision to that document. However, as demonstrated herein, the limits proposed by SkyBridge will protect even systems that depart from the Appendix 30 parameters.

However, DirecTV has failed to take into account in its analysis the noise temperature of the entire link, and has only considered noise from the receiver.^{33/} I/N (or $\Delta T/T$) calculations are performed using the link or system noise temperature and not just the receiver noise temperature. Furthermore, DirecTV computed I/N levels only for the short term situation. In accordance with the protection levels and GSO parameters specified in Appendix 30, SkyBridge has proposed two sets of limits, the first of which corresponds to 99.7% of the time (long term), and the other to 0.3% of the time (short term). Even using only the receiver noise temperature used by DirecTV, the result for the long term situation is an I/N of -18.4 dB, which meets the -12 dB criterion cited by DirecTV.^{34/}

The following calculations, similar to those provided by DirecTV, are performed using a more appropriate 150 K link noise temperature:

^{33/} DirecTV argues that "the limit that SkyBridge has proposed is only 6 dB below the DirecTV subscriber terminal noise floor and to cause no noticeable degradation the interference level must be 12 dB or more below the noise floor of the system." DirecTV Comments at 6 (emphasis added). As noted by DirecTV itself, therefore, the -12 dB criterion is applicable to I/N calculation based on the noise temperature of the entire system, and not just the receiver noise floor. Yet its calculations are based on a value of N that takes into account only the receiver noise temperature.

^{34/} See DirecTV Comments at 6.

	Long Term	Short Term	Units
System Noise Floor (150K)	-208.6	-208.6	dB(W/Hz)
e.p.f.d.	-144	-131	dB(W/m ² /27MHz)
1 / Bandwidth	-74.3	-74.3	dB(1/Hz)
Reference Gain (1 m ² at 12.5 GHz)	-43.4	-43.4	dBi
Peak Gain of DirecTV Dish	34.4 ^{35/}	34.4	dBi
Equivalent Interference Level	-227.3	-214.3	dB(W/Hz)
I/N	-20.5	-7.5	dB

The computations show that 99.7% of the time the clear sky C/N degradation is less than 0.04 dB, which is not measurable. Even during the 0.3% of the time remaining, the clear sky C/N degradation is less than 0.7 dB.

These values are well within the rain margins of the GSO link.

Contrary to DirecTV's assumption, the presence of NGSO systems will not "increase significantly the amount of rain outage experienced by DirecTV customers."^{36/}

During a heavy rain, the GSO satellite carrier (C) will be attenuated. However, the interfering NGSO signal (I) travels through the same rain clouds, and, because it is at the same frequency as the GSO carrier, will be equally attenuated. Therefore, the C/I ratio is unchanged. Furthermore, because the rain increases the sky noise while the

^{35/} This value comes from the DirecTV Comments, at Table 1, for an 18-inch antenna. However, it appears that this gain requires an 80% antenna efficiency, which is presently unobtainable for mass-production antennas. A real world value of antenna efficiency for an 18-inch diameter antenna would be 65%, which corresponds to a 33.5 dBi antenna gain, and would produce I/N ratios of -21.4 and -8.4 dB, for the long term and short term, respectively. Using these values, the clear sky C/N degradations become 0.03 and 0.6 dB, respectively.

^{36/} DirecTV Comment at 7.

interfering signal (I) drops, the effective I/N is reduced. Therefore, the instances of rain outage are not increased.

2. Future systems.

DirecTV also argues that the proposed rules will inhibit innovation and expansion of DBS systems.^{37/} Departure of DBS systems from the parameters assumed in the BSS plans is, of course, expected. Changes primarily involve either an increase in BSS satellite EIRP, or a decrease in the BSS receiver dish size, or both.

The proposed e.p.f.d. limits have been developed using BO1213 antenna diagrams for 60 cm dishes.^{38/} There is, of course, strong interest in using dishes smaller than 60 cm. The small dish case is assessed quantitatively below by computing I/N levels. The short term calculations in the table below correspond to a 30 cm (~ 12 inch) dish, and a link noise temperature of 150K. This temperature does not take into account the interference from other GSO systems in the case of a small antenna; the interference from adjacent GSO systems is going to increase so as to be predominant in the link noise temperature. This, in turn, results in less sensitivity than what is shown below with respect to NGSO systems.

^{37/} See DirecTV Comments at 4; USSB Comments at 2. See also Hughes Comments at 1.

^{38/} DirecTV is incorrect in its statement that only 1-meter antennas (the reference antenna for Region 2 in BO1213) were considered. See DirecTV Comments at 7-8.

	Short Term	Units
System Noise Floor (150K)	-206.8	dB(W/Hz)
e.p.f.d.	-131	dB(W/m ² /27MHz)
1 / Bandwidth	-74.3	dB(1/Hz)
Reference Gain (1 m ² at 12.5 GHz)	-43.4	dB _i
Peak Gain of 30 cm Dish	29.5	dB _i
Equivalent Interference Level	-214.3	dB(W/Hz)
I/N	-12.4	dB

As shown, the short term I/N is below the -12 dB criterion cited by DirecTV.^{39/} The long term I/N will be even lower. Therefore, no noticeable interference will be caused, demonstrating that smaller DBS antenna dishes are not a concern.

Further, a likely consequence of smaller dishes will be an increase in the EIRP of the BSS satellite. In such case, the GSO p.f.d. level at the ground would also increase in the same proportion, and therefore the C/I levels seen by the DBS dishes would be higher. This acts to protect the DBS system even further against NGSO systems.

Finally, studies by SkyBridge indicate that its system can tolerate the BSS satellite EIRP increase that would likely accompany a dish size reduction to 30 cm (and, perhaps, smaller). However, dish size reductions of this magnitude impact the EIRP on other GSO systems, and may raise, inter alia, orbital spacing concerns.

^{39/} DirecTV Comments at 6.

In decreasing dish size, BSS operators are likely to encounter difficulties with adjacent GSO operators long before any NGSO systems are affected.

B. The limits contemplate multiple NGSO systems.

PanAmSat and DirecTV raise the issue of interference caused by multiple NGSO systems operating in the Ku-band.^{40/} As discussed in the SkyBridge Application, the flexibility of the SkyBridge design would facilitate coordination with other NGSO systems,^{41/} and the proposed rules contemplate multiple NGSO constellations.

PanAmSat claims that "the cumulative effects of two or more 'SkyBridge-like' systems would likely cause sufficient interference to constrain future system development in the band."^{42/} This conclusion is entirely unsupported and reflects a serious lack of understanding of NGSO systems.

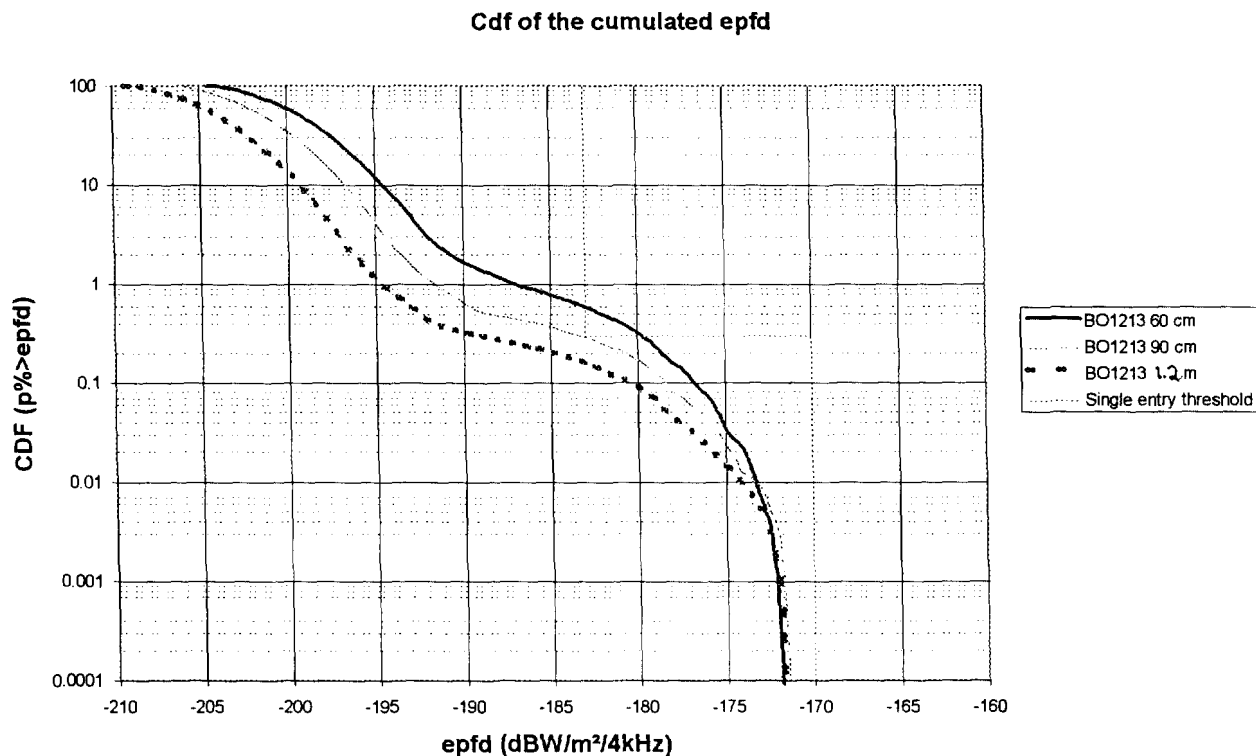
Contrary to the case of GSO networks, the interference provided to a particular communications link created by NGSO systems varies with time. It is elementary that the constellations of two or more independent NGSO systems are uncorrelated, as will be their interference to GSO systems; interfering events cannot simply be summed as PanAmSat suggests. The I/N statistics for two NGSO systems is the convolution, not the sum, of the statistics for each of the individual systems. In particular, short term events will not occur at the same time, and the short term values will never be added together. The statistics of e.p.f.d. produced by two

^{40/} PanAmSat Comments at 3; DirecTV Comments at 7.

^{41/} Application at 75, 88.

^{42/} PanAmSat Comment at 3.

homogeneous NGSO systems is shown below for three antenna types (using BO1213 antenna patterns). The single entry protection level derived from Appendix 30 requirements is also plotted.



No other party advanced any other remotely substantive objection to the proposed limits. To the extent the other parties addressed the proposed limits at all, the emphasis was primarily to suggest that the limits should undergo rigorous evaluation. SkyBridge agrees. This is precisely the purpose of the rulemaking proceeding. The rulemaking will give all concerned parties yet another chance to evaluate and comment on the regime proposed by SkyBridge to protect GSO and FS systems.